Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | | | | | |

Candidate Number | | | | |

Thursday 6 June 2019

Morning (Time: 1 hour 45 minutes) | Paper Reference **9BI0/01**

Biology B

Advanced
Paper 1: Advanced Biochemistry, Microbiology and Genetics

You must have:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Pearson

Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The nucleic acids, DNA and mRNA, are polymers.

(a) The table shows some components that may be found in a molecule of these nucleic acids.

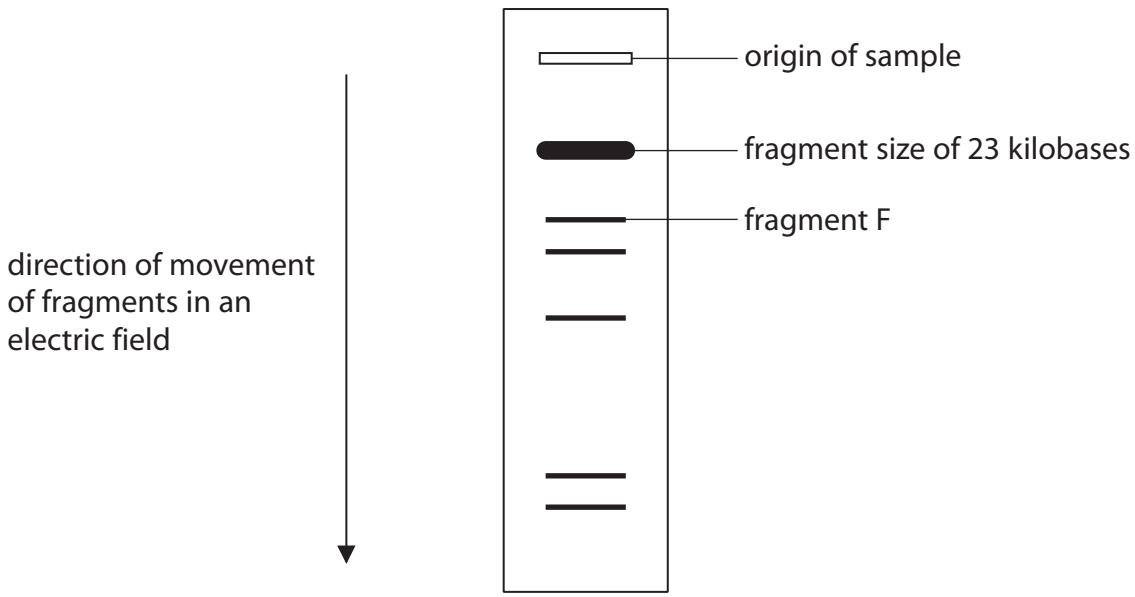
For each component, put **one** cross ☒ in the appropriate box, in each row, to show where these components can be found.

(4)

Component	Component found in a molecule of			
	both DNA and mRNA	DNA but **not** mRNA	mRNA but **not** DNA	neither DNA nor mRNA
Adenine	☒	☒	☒	☒
Hydrogen bonds	☒	☒	☒	☒
Pentose sugar	☒	☒	☒	☒
Uracil	☒	☒	☒	☒

(b) Fragments of DNA can be separated by gel electrophoresis to produce a DNA profile.

The diagram shows an example of a DNA profile.

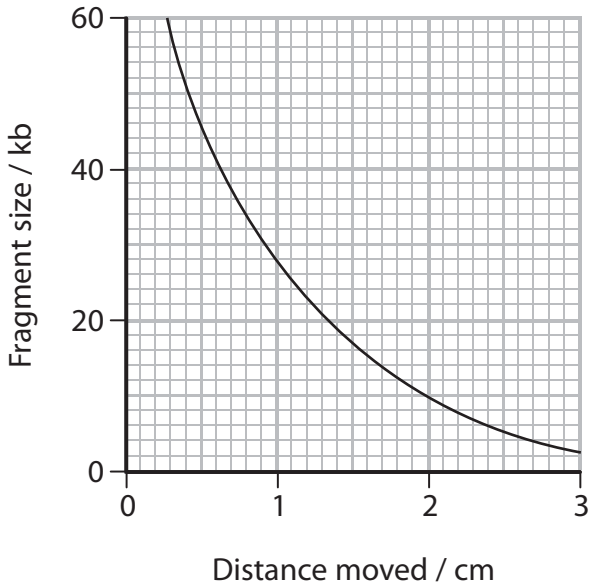


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(i) Explain why fragments of DNA can be separated by gel electrophoresis.

(2)

(ii) The graph shows the relationship between the distance moved in a gel and the fragment size.



Determine the size of fragment F.

(1)

Answer ..... kb

(Total for Question 1 = 7 marks)

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2 Bacteria were cultured in two different types of medium.

One medium contained glucose as the energy source and the other contained sucrose.

The same molar concentrations of glucose and sucrose were used.

(a) Which row of the table identifies these sugars?

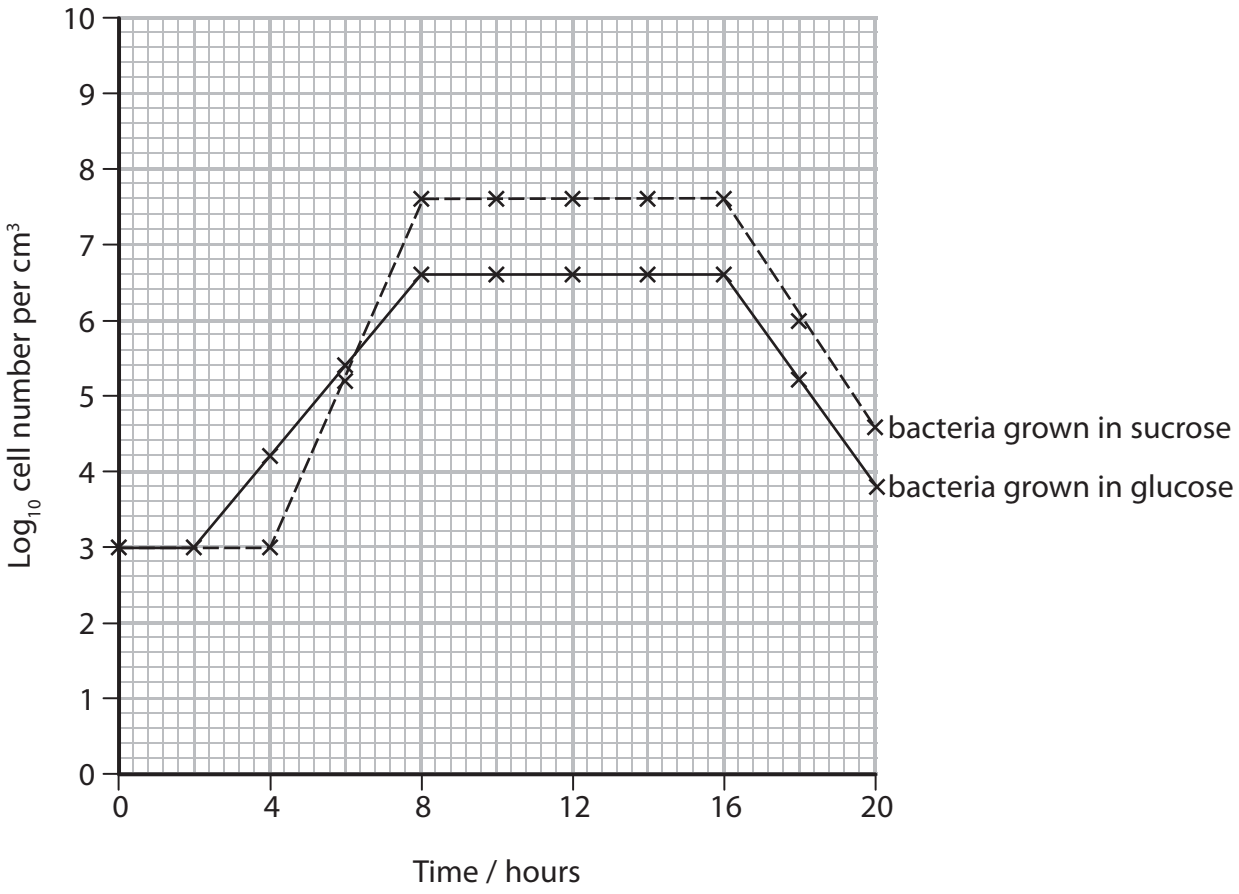
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	Glucose	Sucrose
☒ **A**	monosaccharide	monosaccharide
☒ **B**	monosaccharide	disaccharide
☒ **C**	disaccharide	disaccharide
☒ **D**	disaccharide	monosaccharide

(b) Bacteria were grown in each medium for 20 hours.

Every two hours, the numbers of bacteria were determined using dilution plating and an optical method (turbidity).

The graph shows the results from the dilution plating.



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(i) Calculate how many times faster the bacteria in sucrose reproduce than the bacteria in glucose, during the log phase.

(2)

Answer .....

(ii) Analyse the data to explain why the growth curve for sucrose is different from the growth curve for glucose.

(2)

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(iii) On the graph, draw a curve to show the number of bacteria grown in glucose as determined by the optical method.

(1)

(Total for Question 2 = 6 marks)

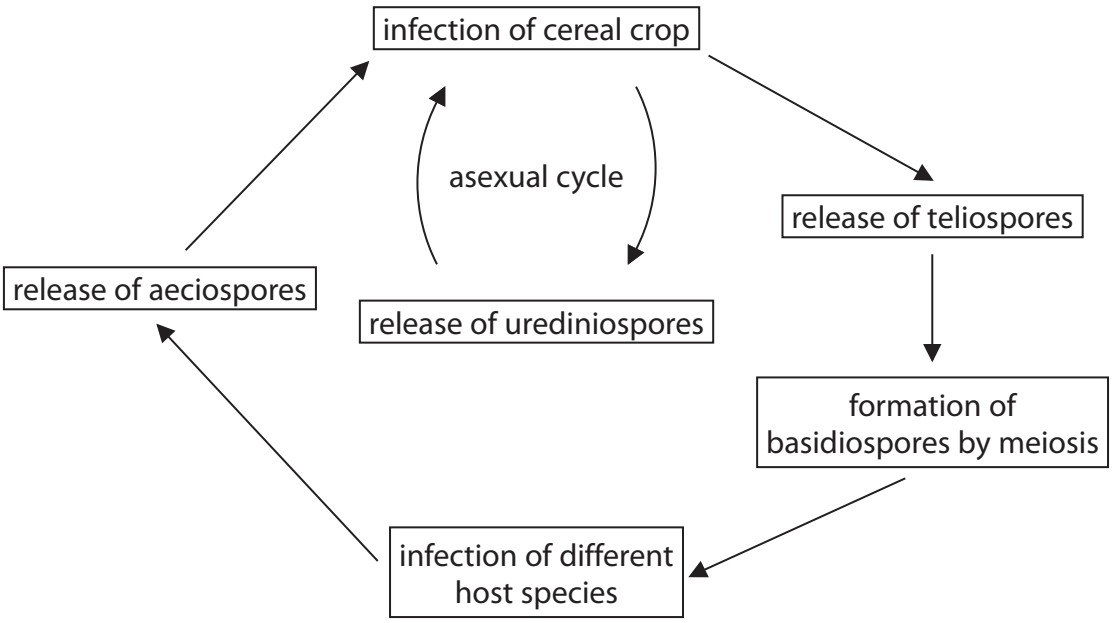
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3 The stem rust fungus is responsible for destroying cereal crops and reducing grain yield.

The diagram shows some stages in the life cycle of the stem rust fungus.



(a) Which genus does the stem rust fungus belong to?

(1)

☒ **A** *Plasmodium*

☒ **B** *Puccinia*

☒ **C** *Salmonella*

☒ **D** *Staphylococcus*

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(b) Explain how stem rust fungus results in a reduction in grain yield.

(3)

(c) Cereal crops have been genetically modified (GM) to produce plants that are resistant to stem rust fungus.

Analyse the diagram to deduce why the formation of basidiospores and urediniospores can produce a stem rust fungus to which these GM plants are no longer resistant.

(3)

(Total for Question 3 = 7 marks)

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4 (a) Photographs **P** and **Q** are electron micrographs of mitochondria.

Each photograph was taken using a different electron microscope.

Photograph **P**



Sourced from: http://book.bionumbers.org/how-big-are-mitochondria/

Photograph **Q**



Source: Cellupedia

(i) What is the structure labelled **S**?

(1)

- ☒ **A** crista
- ☒ **B** matrix
- ☒ **C** stroma
- ☒ **D** thylakoid

(ii) Explain the difference in appearance of the parts labelled **C** using the two different electron microscopes.

(2)

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*(b) The table shows the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

Membrane of mitochondrion	Protein : lipid ratio
inner	3:2
outer	1:1

Explain the difference in the protein : lipid ratio of the inner and outer membrane of a mitochondrion.

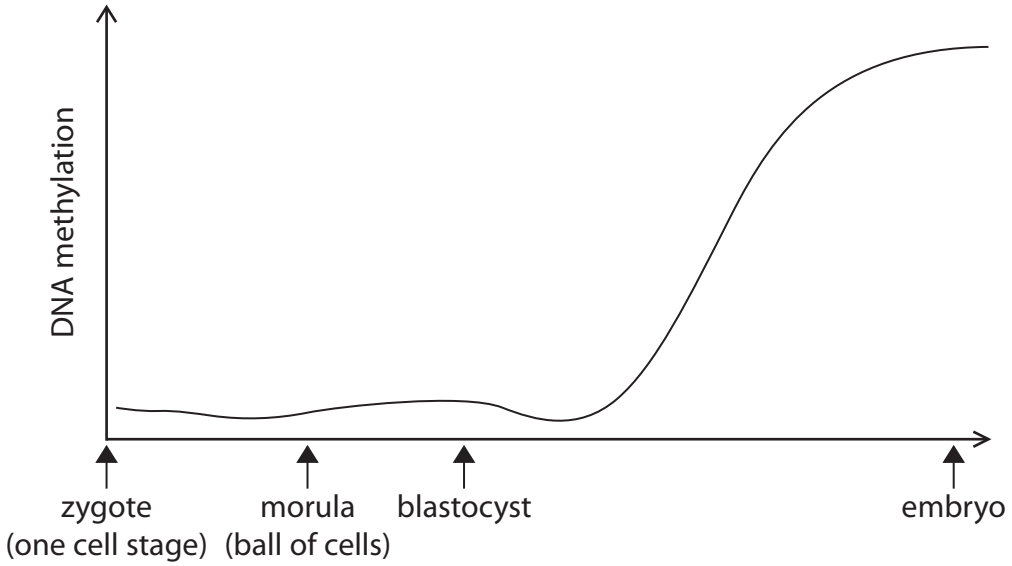
(6)

(Total for Question 4 = 9 marks)

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5 (a) Epigenetic modifications are involved in the development of an embryo.

The graph shows the changes in DNA methylation during the development of an embryo from a zygote.



(i) State the meaning of the term DNA methylation.

(1)

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(ii) Describe the differences between totipotent, pluripotent and multipotent stem cells during the development of an embryo.

(3)

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(iii) Analyse the graph to explain why DNA methylation is involved in the development of an embryo.

(2)

(b) Explain why some cells are not able to become other cell types.

(2)

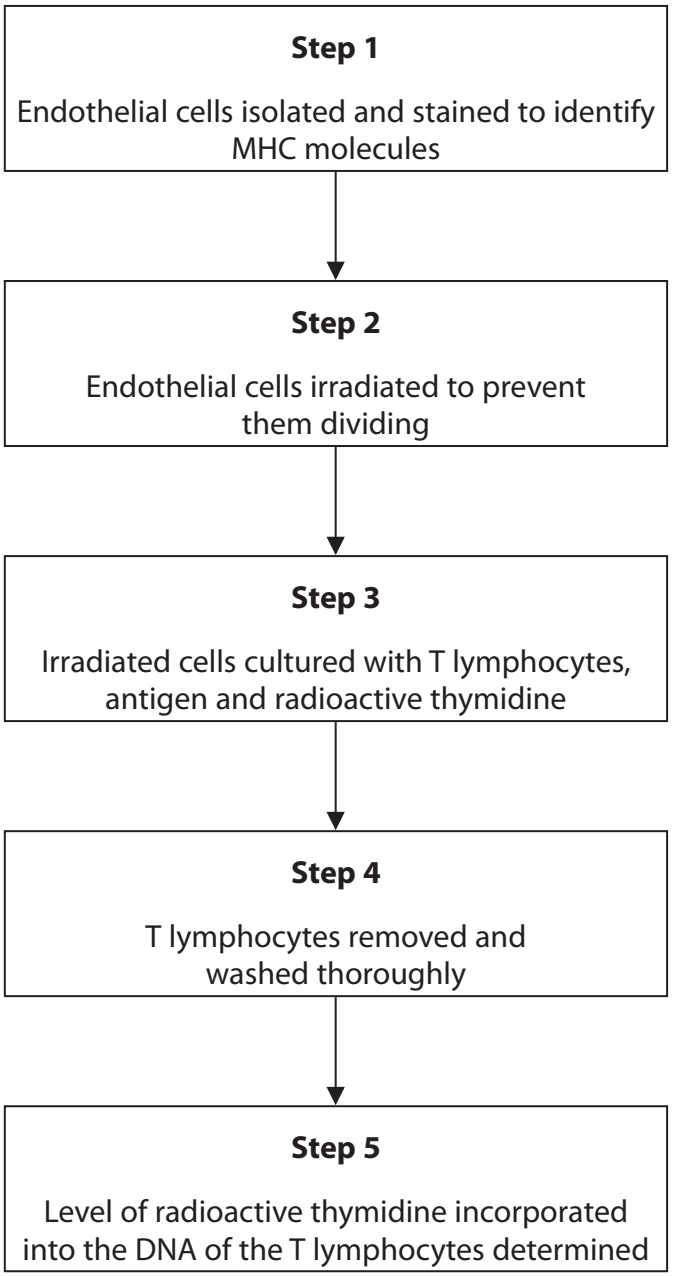
(Total for Question 5 = 8 marks)

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6 Cell division can be measured using radioactive thymidine. This molecule is used in the synthesis of new DNA molecules.

A scientist investigated the ability of endothelial cells to present antigens.

The flow chart shows some of the steps involved in this investigation.



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(a) Explain why the scientist looked for the presence of MHC molecules on the endothelial cells, in Step 1.

(2)

(b) Irradiation prevents cells from dividing.

Explain why the endothelial cells were irradiated in Step 2, before they were cultured with T lymphocytes and antigen.

(2)

(c) Explain why the T lymphocytes needed to be washed thoroughly in Step 4.

(2)

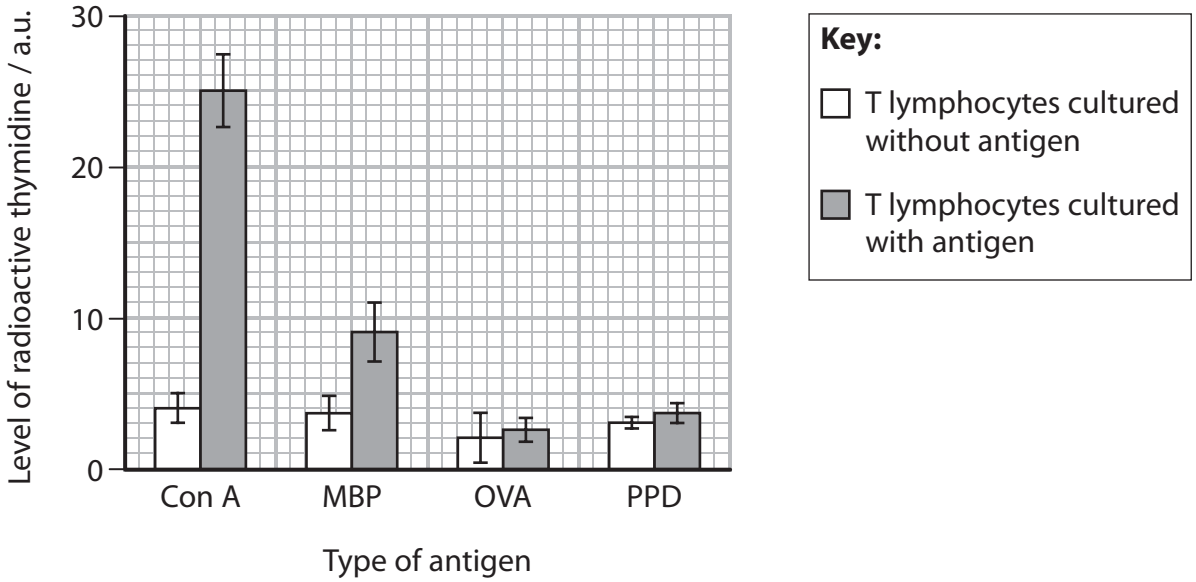
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(d) In this investigation, the ability of the endothelial cells to present four different types of antigen was assessed.

T lymphocytes were cultured with endothelial cells and antigen.

This was repeated using T lymphocytes cultured with endothelial cells and no antigen.

The graph shows the results of this investigation.



(i) Explain why T lymphocytes were cultured with and without the antigen.

(2)

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(ii) Analyse the data to explain the conclusions that can be drawn from this investigation.

(3)

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(Total for Question 6 = 11 marks)

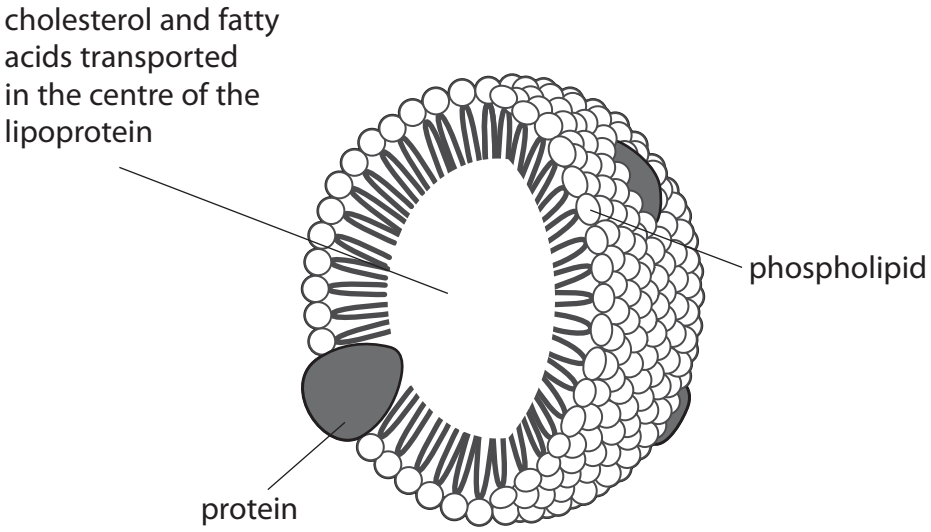
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7 High density and low density lipoproteins are spherical structures that transport cholesterol and fatty acids in the bloodstream.

The diagram shows a lipoprotein.



(a) Explain why the properties of lipoproteins enable cholesterol and fatty acids to be transported in the bloodstream.

(3)

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(b) The table shows some information about two types of lipoprotein, high density lipoprotein (HDL) and low density lipoprotein (LDL).

Information about lipoproteins	HDL	LDL
density range / g cm^{-3}	1.063 to 1.210	1.019 to 1.063
typical diameter / nm	8	22
typical volume / nm^3	268	
percentage of protein (%)	50	20

(i) Complete the table to show the volume of a typical LDL using the formula:

$$\frac{4}{3}\pi r^3 \quad \text{where } \pi = 3.14$$

(2)

(ii) Analyse the information to explain why LDLs have a lower density range than HDLs.

(2)

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(iii) Explain why raised levels of LDLs may increase the risk of heart disease.

(4)

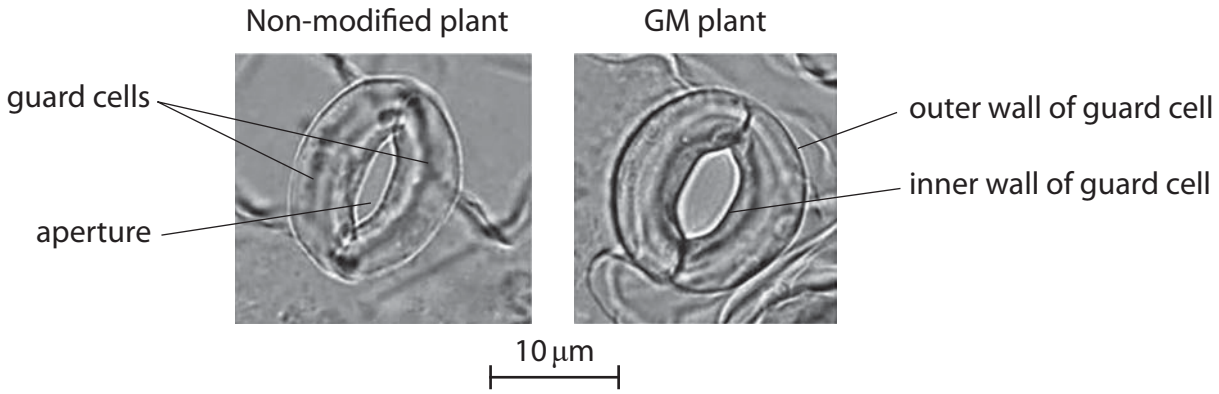
(Total for Question 7 = 11 marks)

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8 Genetically modified (GM) crop plants have been produced that have stomata with a wider aperture than non-modified crop plants.

This difference in the width of the aperture is only evident in daylight.

The photographs show the appearance of each type of stoma in daylight.



Sourced from: http://www.aip.nagoya-u.ac.jp/en/public/nu_research/images/Wang_f1.jpg

(a) (i) Calculate the magnification of the GM plant photograph using the scale bar.

Give the answer in standard form.

(2)

Answer .....

(ii) Calculate how many times wider the aperture of the stoma of the GM plant is compared with the stoma of the non-modified plant.

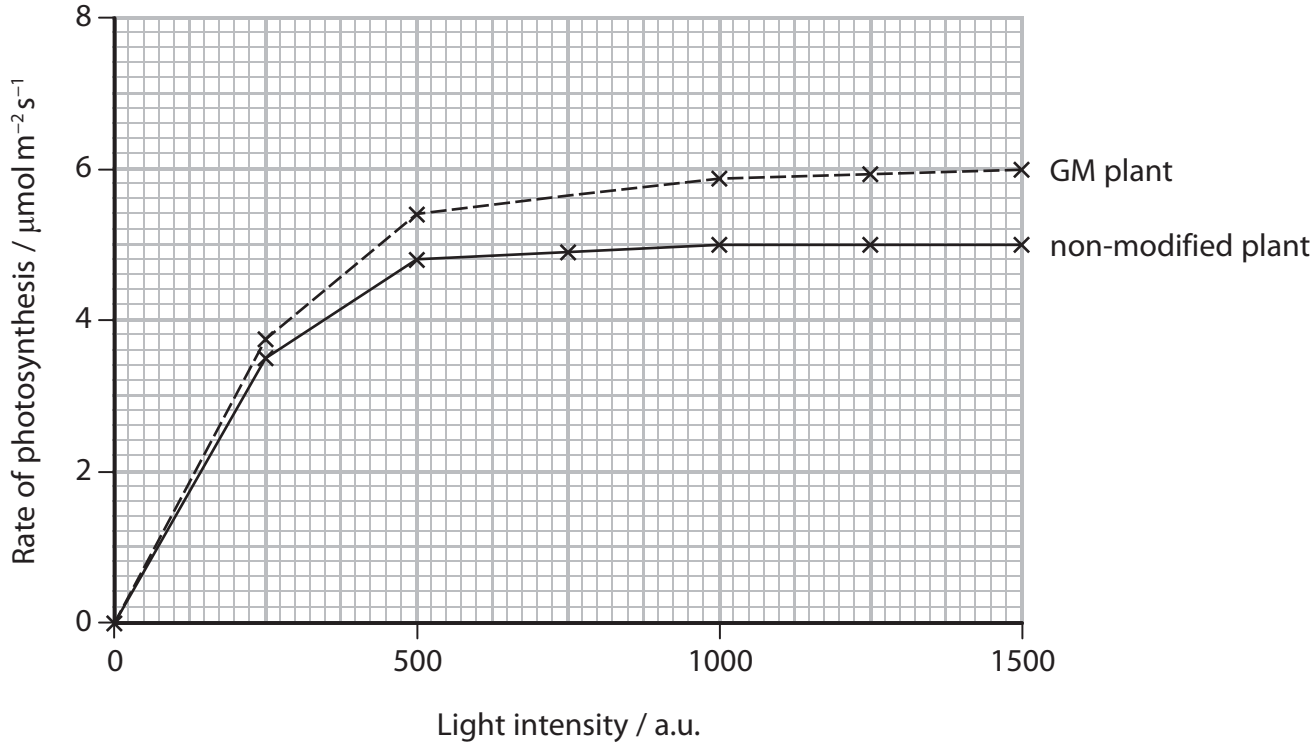
(1)

Answer .....

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(b) An investigation was carried out to compare the effect of light intensity on the rate of photosynthesis in GM plants with the effect in non-modified plants.

The graph shows the results of this investigation.



(i) The rate of photosynthesis is expressed as $\mu mol\, m^{-2}\, s^{-1}$.

Describe what was measured to find the rate of photosynthesis.

(3)

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(ii) Explain the results of this investigation.

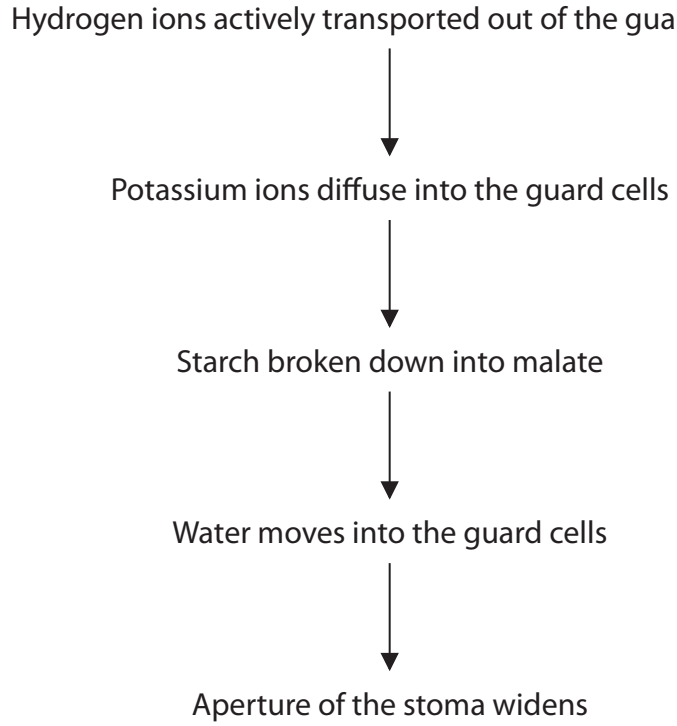
(3)

(c) Explain why the wider stomata in GM crop plants could increase their yield.

(3)

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(d) The flow chart shows some of the steps involved in opening the aperture of a stoma.



(i) What happens when hydrogen ions are actively transported out of the guard cells?

(1)

☒ **A** ADP and phosphate ions are converted into ATP by a hydrolysis reaction

☒ **B** ADP and phosphate ions are converted into ATP by a condensation reaction

☒ **C** ATP is broken down into ADP and phosphate ions by a condensation reaction

☒ **D** ATP is broken down into ADP and phosphate ions by a hydrolysis reaction

(ii) Which of the following explains why water moves into the guard cells?

(1)

☒ **A** malate lowers the water potential of the cytoplasm

☒ **B** malate raises the water potential of the cytoplasm

☒ **C** starch lowers the water potential of the cytoplasm

☒ **D** starch raises the water potential of the cytoplasm

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(iii) Which of the following explains why the aperture of the stoma widens?

(1)

☒ **A** The guard cells become smaller and the inner wall of the guard cell is more flexible than the outer wall

☒ **B** The guard cells become smaller and the inner wall of the guard cell is less flexible than the outer wall

☒ **C** The guard cells become larger and the inner wall of the guard cell is more flexible than the outer wall

☒ **D** The guard cells become larger and the inner wall of the guard cell is less flexible than the outer wall

(Total for Question 8 = 15 marks)

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9 Doxorubicin (Dox) is a drug used to treat cancer.

(a) Cancer is caused when cells divide uncontrollably.

This drug works in two ways:

- it becomes inserted into the DNA and holds the two strands together.
- it binds to an enzyme that repairs DNA.

Explain how Dox prevents cancer cells from dividing.

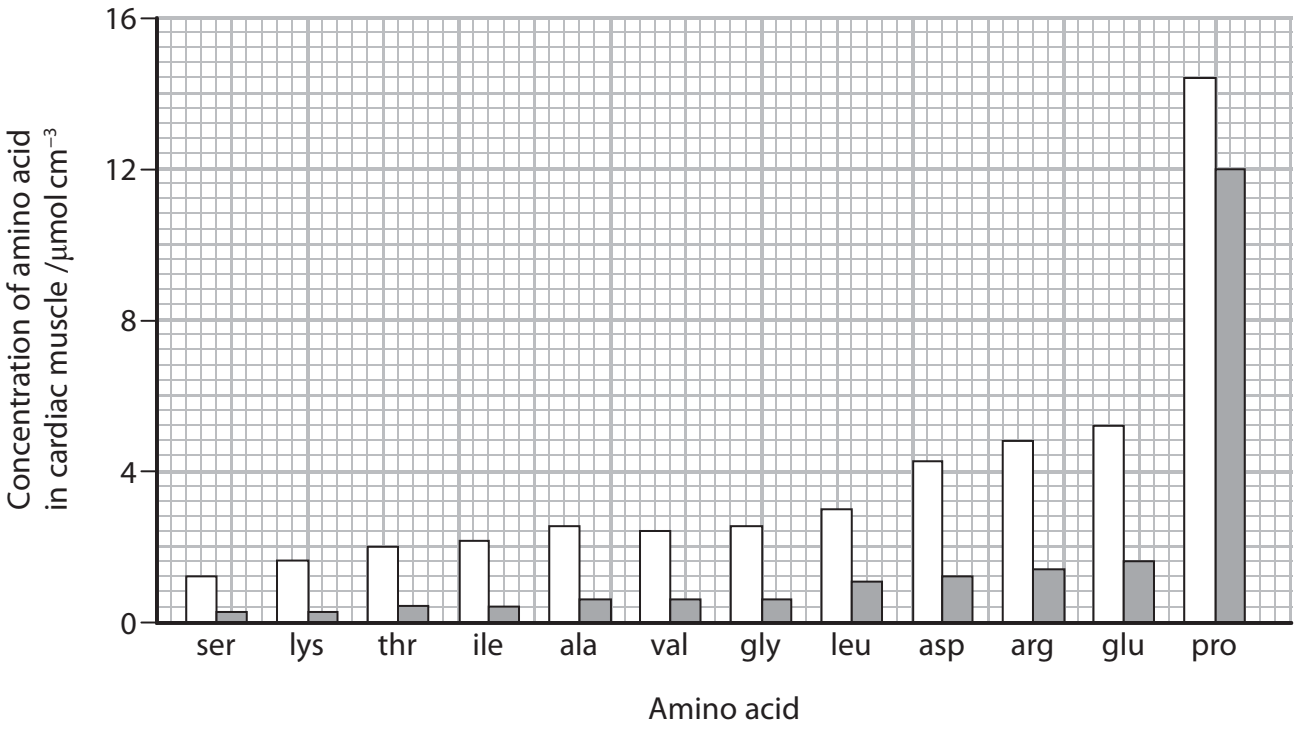
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(b) Weakening of the cardiac muscle is one side effect of using Dox.

The effect of Dox on the concentration of several amino acids in cardiac muscle was investigated.

The graph shows the results of this investigation.



The table shows some non-polar and polar amino acids.

Type	Amino acids
non-polar	ala, gly, ile, leu, pro, val
polar	arg, asp, glu, lys, ser, thr

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*(i) Analyse the information to determine the effect of Dox on the concentration of these types of amino acid in cardiac muscle.

(6)

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(ii) Explain why a change in the concentration of amino acids results in the weakening of cardiac muscle.

(2)

(iii) Explain how weakening of the cardiac muscle could affect a person.

(3)

(Total for Question 9 = 16 marks)

TOTAL FOR PAPER = 90 MARKS

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